

WHAT IS CLAIMED IS:

1. A process for the production of doped, organic semiconductor materials with elevated charge carrier density and effective charge carrier mobility by doping with a doping agent, in which the doping agent is substantially produced by electro-crystallization in a first step, the doping agent is selected from a group of organic compounds with a low oxidation potential, and in which an organic semiconductor material is doped with the doping agent in a second step.
2. The process according to Claim 1, characterized in that a salt of the organic doping agent is used as educt for the electro-crystallization.
3. The process according to Claim 2, characterized in that a singly or multiply charged cation is used in the educt salt of the organic doping agent.
4. The process according to any one of Claims 1 to 3, characterized in that an uncharged organic compound is used as doping agent.
5. The process according to any one of Claims 1 to 4, characterized in that the doping agent is crystallized out on a working electrode and is subsequently harvested on the working electrode.
6. The process according to Claims 5, characterized in that the doping agent is purified in an intermediate step after the harvesting on a working electrode during the electro-crystallization.
7. The process according to any one of Claims 1 to 6, characterized in that a compound with an oxidation potential of less than 0 V against NHE is used as doping agent.

8. The process according to Claim 7, characterized in that a compound with an oxidation potential in a range of ~ 0.5 V against NHE to ~ 2.5 V against NHE is used as doping agent.
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9. The process according to any one of Claims 1 to 8, characterized in that bis (2,2'-terpyridine) ruthenium is used as doping agent.
10. The process according to any one of Claims 1 to 8, characterized in that tris (4,4',5,5'-tetramethyl-2,2'-bipyridine) chromium is used as doping agent.
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11. Doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility, produced by a process in accordance with Claims 1 to 10.
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12. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to Claim 11, characterized in that the semiconductor material is doped with bis (2,2'-terpyridine) ruthenium.
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13. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to Claim 11, characterized in that the semiconductor material is doped with tris (4,4',5,5'-tetramethyl-2,2'-bipyridine) chromium.
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14. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to any one of Claims 11 to 13, characterized in that the matrix of the semiconductor material contain fullerene.
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15. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to any one of Claims 11 to 14, characterized in that the matrix of a semiconductor material contains phthalocyanine zinc.
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16. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to Claim 11, characterized in that the semiconductor material has a conductivity of approximately 10^{-1} S/cm at room temperature, that the matrix of the semiconductor material contains fullerene and that the semiconductor material is doped with bis (2,2'-terpyridine) ruthenium.
17. The doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility according to Claim 11, characterized in that the semiconductor material has a conductivity of approximately 10^{-6} S/cm at room temperature, that the matrix of the semiconductor material contains phthalocyanine zinc and that the semiconductor material is doped with bis (2,2'-terpyridine) ruthenium.
18. A diode consisting of doped, organic semiconductor material with elevated charge carrier density and effective charge carrier mobility, characterized in that the diode comprises doped, organic semiconductor material according to any one of Claims 11 to 17.
19. The diode according to Claim 18, characterized in that the diode is a metal-isolator-N-doped semiconductor (*min*).
20. The diode according to Claim 19, characterized in that the diode is a p-doped semiconductor-isolator-N-doped semiconductor (*pin*).
21. The diode according to any one of Claims 18 to 20, characterized in that the diode has a rectification ratio of at least 10^5 .
22. The diode according to any one of Claims 18 to 21, characterized in that the diode has a built-in voltage of approximately 0.8 V.